



S A N D I A

LAB NEWS

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World's smallest, best acoustic amplifier emerges from 50-year-old hypothesis

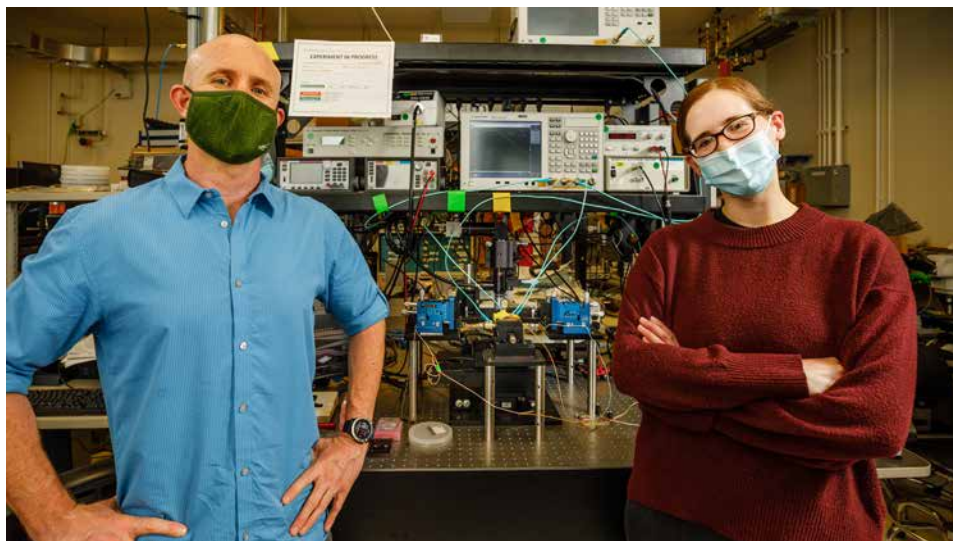
Acousto-electric devices reveal new road to miniaturizing wireless tech

By **Troy Rummler**

Sandia scientists have built the world's smallest and best acoustic amplifier. And they did it using a concept that was all but abandoned for almost 50 years.

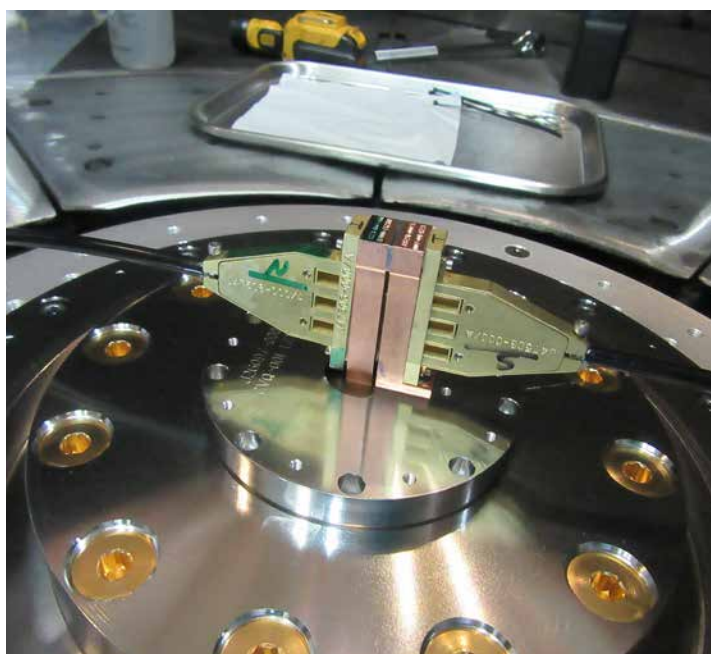
According to a paper published last month in [Nature Communications](#), the device is more than 10 times more

— CONTINUED ON PAGE 9



AMPED UP — Scientists Matt Eichenfield, left, and Lisa Hackett led the Sandia team that created the world's smallest and best acoustic amplifier.

Photo by Bret Latter



READY, AIM, FIRE — Shown is the complete target assembly inside the Z machine for the high-pressure materials experiments coordinated with researchers at Lawrence Livermore National Laboratory. The samples are invisible because they are covered by probes.

Photo by Leo Molina

Labs join forces to set gold, platinum standards

Research at extreme pressure at Sandia and Lawrence Livermore national labs

by **Neal Singer**

Like two superheroes joining forces, Sandia's Z machine, generator of the world's most powerful electrical pulses, and Lawrence Livermore National Laboratory's National Ignition Facility, the planet's most energetic laser source, in a series of 10 experiments have detailed the responses of gold and platinum at pressures so extreme that their atomic structures momentarily distorted like images in a funhouse mirror.

Similar high-pressure changes induced in other settings have produced oddities like hydrogen appearing as a metallic fluid, helium in the form of rain and sodium a transparent metal. But until now

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LAB NEWS Notes

EDITOR'S NOTE: We've stopped printing the *Lab News*, but will continue to publish every two weeks. We want you to remain in our community of readers, so please send your comments and suggestions for stories or for improving the paper. *Lab News* welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact *Lab News* editor Jim Danneskiold at jddanne@sandia.gov.

Sandia helps lead technical reference reports for photovoltaic community

By **Kelly Sullivan**

Sandia researcher Joshua S. Stein co-led work resulting in two recent reports that aim to advance the development of photovoltaics.

The **International Energy Agency Photovoltaic Power Systems Programme (PVPS)** reports focused on bifacial modules and systems and the design of new photovoltaic materials.

The reports, which were released this spring, act as technical references on the state of the photovoltaics field and address the issues that are important to industry stakeholders, Joshua said.

"The bifacial report is the culmination of several years of work with an outstanding group of researchers from around the world," Joshua said.

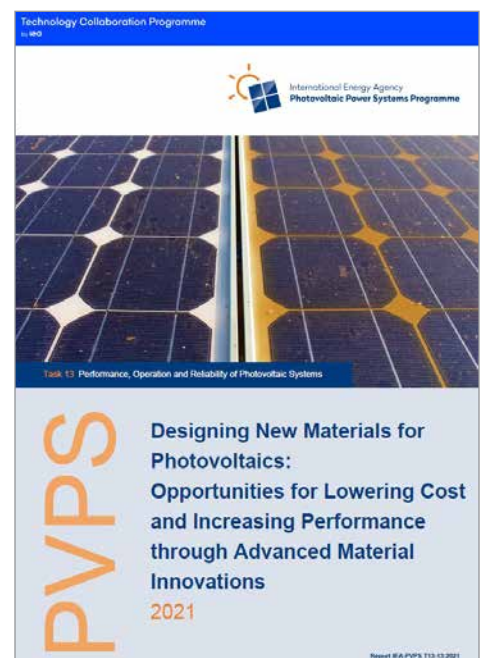
Joshua is a member of the agency program's group that focuses on photovoltaics performance and reliability and aims to

"provide support to market actors working to improve the operation, the reliability and the quality of PV components and systems," according to the International Energy Agency.

Two-sided photovoltaic systems popular

"**Bifacial Photovoltaic Modules and Systems: Experience and Results from International Research and Pilot Applications**," examines the growing popularity of bifacial photovoltaic cells, modules and systems.

Recently, bifacial photovoltaics on single-axis trackers have become the solar technology with the lowest levelized cost of energy in most parts of the world. New cell designs have replaced opaque, monolithic back surface foil contacts and allow light to reach the cell from the rear, resulting in bifacial solar cells with rear side efficiencies from more than



TWO OF A KIND — Sandia researcher Joshua S. Stein co-led activities for two national reports that focus on bifacial modules and systems and the design of new photovoltaic materials.

60% to 90% of the front side. These cells now come in several varieties and many manufacturing lines have converted to producing bifacial cells.

The study considered newly discovered degradation issues specific to bifacial cells due to such causes as light and elevated temperatures, and rear side potential induced degradation, as well as new optimized bifacial systems and models.

For example, the study evaluated the state of the art of bifacial PV performance models. Researchers defined four hypothetical system designs and two designs based on field measurements.

Then, necessary input parameters and weather files were provided to volunteers from 13 different research and commercial entities, each with their own bifacial PV performance model. The report described each model in detail, with a range of results, with some models unable to simulate all the scenarios. The predicted gains for some of the different bifacial systems were as great as double, which showed the value of defining standard test cases to verify and validate the models.

The last section of this report provides a summary of 11 bifacial field test sites around the world, along with examples of field results. Many of these sites include a variety of bifacial test arrays with different orientations, designs and site conditions.

Joshua and Christian Reise of Fraunhofer ISE in Freiburg, Germany, were the report's lead co-authors. In total, 49 international scientists contributed to the publication, including Sandia researchers Cameron Stark and Dan Riley.

Examining the growing market for photovoltaics

The second study, "[Designing New Materials for Photovoltaics: Opportunities for Lowering Cost and Increasing Performance through Advanced Material Innovations](#)," examines the rapidly growing photovoltaic market, including the dramatic drop in module prices.

"There is concern in the PV industry that falling module prices may result in lower quality and reliability issues," said Joshua. "This report helps stakeholders better understand the opportunities for higher performance and lower cost that new materials

can offer, and also reviews current efforts to ensure long module lifetimes."

The report provides a global survey from agency member countries of efforts to design new materials for photovoltaic cell and module applications. Researchers organized the report by module component and included reviews of material innovations in front-sheets, encapsulants, back-sheets, cell metallization and cell interconnects. Included are sections on the state of the art in photovoltaic module materials, the functional requirements of each component and materials typically used to meet the requirements; motivations for applying new material solutions to PV modules; and a global survey of novel material solutions under development and testing for the next generation of modules.


"This report helps stakeholders better understand the opportunities for higher performance and lower cost that new materials can offer, and also reviews current efforts to ensure long module lifetimes."

Joshua was second author of the report, after Gernot Oreski of the Polymer Competence Center Leoben in Austria. A total of 24 researchers and scientists from around the world contributed.

More information is available at the [PV Performance and Modeling Collaborative](#)

about the IEA Photovoltaic Power Systems Programme's TASK 13 reports, and more is also available about the [International Energy Agency](#) programs.

Sandia also is co-sponsoring

the [15th Photovoltaic Performance Modeling Collaborative Workshop](#) in Salt Lake City, Utah, from Oct. 19-20. Also sponsored by CFV Labs and [GroundWork Renewables](#), the workshop will examine technical challenges and opportunities of photovoltaic systems. 

MISSION
FORWARD

This is why I got vaccinated.



They're safe. They keep you safe. They keep others safe. coronavirus.sandia.gov

Connecting with others through art

By **Emily Rada**

With in-person socialization on hold, many are seeking new ways to connect and have fun. Painting can improve concentration, relieve stress, increase creativity and be a meditative activity.

“Research finds that creative activity can reduce your stress, regardless of artistic experience or talent,” said counselor Sharon Johnson of the Employee Assistance Program. “Painting is an excellent addition to self-care allowing us to let go of any problems in the forefront of our minds and put us in a more meditative state.”

Preventive health hosts virtual paint night

The idea to offer a virtual paint night came from Sandia/CA Employee Health Services Manager Rosalind Turner.

“She knows that my hobby is painting and thought it would be a creative way to engage our employees,” said health educator and longtime painter Emily Rada.

While Emily typically leads fitness classes, she says teaching painting classes is similar.

“In my fitness classes, I give cues on where to put your feet and how to move your body. With painting, I give directions on how much color to add and how to move the brush,” she explained. “Both exercise and art have the capability to reduce stress levels and put people in better moods.”

Emily hosted the first virtual paint night in February and the subject was “Flowering Cacti.” Thirty-five painters attended and many requested a second session. In March, a “Poppy Landscape” inspired 45 more budding artists who were employees, spouses, friends and children.

Participants were chatting, laughing and answering art-related trivia during class. Some added hot-air balloons, orange and red skies and Italian villas to their pictures.




LEARNING THE BASICS — Emily Rada leads a group through painting basics in a series of virtual events. **Photo courtesy of Emily Rada**

Attendee Jessica Morning said, “Thank you so much for hosting the paint night. It made my evening feel like one from the good old days (last year).”

No artistic background required

The art supplies and subjects are simple, and the step-by-step instructions are covered in an hour, so even the youngest painters can complete a work of art.

Attendee Korrie Mabray said, “[This] may be the first Zoom class my 6-year-old actually liked!”

The next Virtual Paint Night will be Thursday, July 22, at 5 p.m. PDT. For more information and a list of art supplies, contact saludca@sandia.gov. 



CREATIVE INTERPRETATION — Emily Rada’s virtual painting classes are simple enough for beginners, while allowing artists to add their own unique details. The “Flowering Cacti” painting was taught in February at the first session.

Photos courtesy Emily Rada

Pride Month

Angela Norris talks about asexual orientation

By **Stephanie Holinka**

June is Pride Month, a good time to reflect on how Sandia's diversity reflects national changes in such areas as sexual orientation and gender identity.

More adults of all orientations are **single than ever**, and not all experience single life the same. The ways people think about their sexual orientation and gender identity reflect those differences.

Sandia staff member Angela Norris identifies as asexual. She explains that at the core of an asexual identity is a lack of interest in sex.

"Growing up, there was a lot of talk about 'When you have sex' but nobody ever talked about 'if.' The idea of never having sex wasn't an option," Angela said.

Angela figured out that she was asexual more than a year ago.

"I did National Coming Out Day. Not much in my life has changed other than I understand that I never want to have sex, and that's normal. I would literally sabotage relationships because I didn't want sex to be a part of my life down the road," Angela said.

Learning that she was not alone has made a huge impact on her life.

"Finding that term and that community makes a big difference because I learned I'm not weird or broken," Angela said.

"The whole subject of sex can be kind of exhausting," she said. "I realize that I watch a lot of cartoons and kid's shows because the PG-rated romance is more aligned with what I want in my love life. The more adult a show is, the more likely the romance is sexually driven, and I can't connect with it."

In the past, people have said to Angela that she'll change her mind as she gets older. She disagrees.

"I've always been this way but just had no words for it. Heteronormative narrative says that everyone has to be with someone

and have sex, but that's not true," she said. "I'm not being difficult, and I don't have a low sex drive."

Angela identifies as asexual, but not asexual, or devoid of romantic feelings for other people.

"For me, this means being open to romantic relationships with a partner but minus the sexual component," she said. "As I've met more people, I've learned that it's not a weird thing to feel this way. There's a whole community of people like me."

Angela is open to the possibility of having a life partner.

"Many people don't understand that you can be asexual but not be single. Love and sex aren't always intertwined," she said.

"I would love to have a partner whom I love with all my heart. I'm not against having a family in the future. Maybe someday, I'll adopt a child with a partner. But maybe not," Angela said.


As the broader culture reflects these and other changes in how people live, Angela hopes that the workplace will become more flexible to accommodate



NYGMA THE ENIGMA — Angela relaxing with her cat Mr. Nygma. **Photo by Angela Norris**

workers who are without partners and children.

Angela has encountered people who say they feel badly for her and tell her she's somehow missing something in her life. Angela said she does not feel that way at all.

"This is who I am. I'm happy," she said. "If I was sad about my life, you could be sad. But why would you be sad if I'm not?" 



PRIDE PICNIC — As part of its Pride Blitz, Sandia Pride Alliance Network board members, left to right Francisco Alvarez, Josh Crawford (behind Francisco) visited with new employee Ben Close and other Sandia staff at Hyder Park as part of an informal, socially distanced social, the group's first in-person event since the start of the pandemic.

Photo by Stephanie Holinka

Mileposts



Carmela Gallegos 40



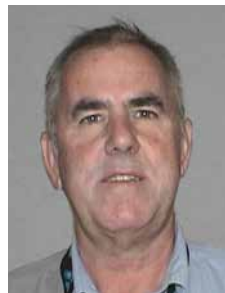
Ed Duckett 35



Mark Ekman 30



Richard Neiser 30



Randy Mayer 25



John McGlinchey 25



Tedd Rohwer 25



David White 25



Eric Coker 20



Jeff Dabling 20



Russell DePriest 20



Chris DiAntonio 20



John Fulton 20



Tameka Huff 20



Rob Iverson 20



Jennifer Long 20



Shauna Moore 20



Larry Musson 20



Nathan Peterson 20



Adrian Sanchez 20



Troy Satterthwait 20



Rene Sells 20



Lucille Shaw 20



Jerry Smith 20



Josh Stein 20



Doug Thompson 20



Rick Chadwick 15



Ernest Hardin 15



Michael Stromberg 15



Debra Williams 15

Sandia gives awards, mentoring to local girls



By **Michael Langley**

A three-decade tradition connecting young Bay Area and northern California high school students with accomplished Sandia scientists was not stopped by the COVID-19 pandemic.

This spring, more than 70 students, parents, mentors and educators virtually attended the 30th Sandia Women's Connection Math and Science Awards. Honorees were nominated by their teachers for the Outstanding Achievement in Science and Outstanding Achievement in Math awards and represented 18 Bay Area and Central Valley high schools.

"When we look more broadly at mechanical engineering, math and other fields, there is a very significant gap in these career paths between women and men," Andy McIlroy, associate labs director for Integrated Security Solutions, told the attendees. "One of the things we're hoping to address tonight is to connect you with female mentors. We hope to illustrate some of the many careers available to you in math and science at Sandia."

Keynote speaker and Sandia virologist Brooke Harmon, whose work to help understand the COVID-19 virus has informed research around the world, told the female students that they should use their personal experiences as motivation to excel and succeed.


"My grandmother was diagnosed with early-onset Alzheimer's. That developed in me a passion to make a change," Brooke said. "I feel like the work that I do on a daily basis is important, and I feel passionate to help people understand what happens when you get infected with COVID-19.

Don't be afraid to talk to scientists. Or teachers or professors. We love that. Find something you're interested and passionate about, and ask us about our studies."

The recipients of the Outstanding Achievement in Math Award were: Kimberley Auman from Lathrop High School in Lathrop; Reese Chy from Granada High School in Livermore; Celeste Guerrero from East Union High School in Manteca; Lucia Gutierrez from Livermore High School in Livermore; Andrea Jia from Dublin High School in Dublin; Hannah Lee from Foothill High School in Pleasanton; Isabel Lozano Lopez from ARISE High School in Oakland; Shaela McCray from McClymonds High School in Oakland; Jennifer Nguyen from Merrill F. West High School in Tracy; Jacqueline Prawira from Mountain House High School in Mountain House; Melanie Sanchez from Skyline High School in Oakland; Sydney Skaggs from Millennium High School in Tracy; Kylie Van Os from Tracy High School in Tracy; Miriam Waldvogel from Lincoln High School in Stockton; and Deanna Wood from Amador Valley High School in Pleasanton.

The recipients of the Outstanding Achievement in Science Award were: Nasya Anderson from McClymonds High School; Karly Arong from Lincoln High School; Annelyse Combittsis from Livermore High School; Crysuel Cunanan from Millennium High School; Yahaira Lino Flores from ARISE High School; Keerat Goraya from Foothill High School; Avneet Gosal from Manteca High School in Manteca; Nikhila Juluri from Dublin High School; Kanksha Koti from Granada High School; Amara McEvoy from Skyline High School; Anshika Ojha from Amador Valley High

School; Hiya Pandya from Tracy High School; Maria Ramirez from Castlemont High School in Oakland; Sophia Stagnaro from John C. Kimball High School in Tracy; Danielle Stengel from East Union High School; Cindy Ta from Mountain House High School; and Ida Voong from Oakland Technical High School in Oakland.

More information about the Outstanding Achievement in Science and Outstanding Achievement in Math awards is available at [Sandia's website](https://www.sandia.gov/labnews). 

Gold and platinum

CONTINUED FROM PAGE 1

there has been no way to accurately calibrate these pressures and responses, the first step to controlling them.

Said Sandia manager Chris Seagle, an author of a [technical paper](#) recently published by the journal *Science*, “Our experiments are designed to measure these distortions in gold and platinum as a function of time. Compression gives us a measurement of pressure versus density.”

Following experiments on the two big machines, researchers developed tables of gold and platinum responses to extreme pressure.

“These will provide a standard to help future researchers calibrate the responses of other metals under similar stress,” said Jean-Paul Davis, another author and Sandia lead scientist in the effort to reliably categorize extreme data.

Data generated by experiments at these pressures — roughly 1.2 terapascals (a terapascal is a trillion pascals), an amount of pressure relevant to nuclear explosions — should aid in understanding the composition of exoplanets, the effects and results of planetary impacts and how the moon formed.

The technical unit called the pascal is so small it is often seen in its multiples of thousands, millions, billions or even trillions. It may be easier to visualize the scale of these effects in terms of atmospheric pressure units. The center of the Earth is approximately 3.6 million times the atmospheric pressure at sea level, or 3.6 million atmospheres. Z’s data reached 4 million atmospheres, or four million times atmospheric pressure at sea level, while NIF reached 12 million atmospheres.

The force of the diamond anvil

Remarkably, such pressures can be generated in the laboratory by a simple compression device called a diamond anvil.

However, “We have no standards by which to measure these extreme ranges,” said Jean-Paul. “While investigators see interesting events, they are hampered in comparing them with each other because what one researcher presents at 1.1 terapascals is only 0.9 on

another researcher’s scale.”

What’s needed is an underlying calibration tool, such as the numerical table these experiments helped to create, he said, so that scientists are talking about results achieved at the same documented amounts of pressure.

“The Z-NIF experiments will provide this,” Jean-Paul said.

The overall experiments, under the direction of Lawrence Livermore researcher D. E. Fratanduono, relied on Z machine’s accuracy as a check on NIF’s power.

Z’s accuracy, NIF’s power

Z’s force is created by its powerful shockless magnetic field, generated for hundreds of nanoseconds by its 20 million-ampere pulse. For comparison, a 120-watt bulb uses one ampere.

The accuracy of this method refocused the higher pressures achieved using NIF methods.

NIF’s pressures exceeded those at the core of the planet Saturn, which is 850 gigapascals. But its laser-compression experiments sometimes required a small shock at the start of the compression wave. This raises the material’s temperature, which can distort measurements intended to set a standard.

“The point of shockless compression is to keep the temperature relatively low for the materials being studied,” said Chris. “Basically, the material does heat as it compresses but it should remain relatively cool, hundreds of degrees, even at terapascal pressures. Initial heating is a troublesome start.”

Another reason that Z, which contributed half the number of “shots,” or



SOLID GOLD — Eight gold samples, four per panel, are shown prior to assembly of the panels into a “stripline” target for Z. There they were vaporized by the enormous pressures produced by Z’s 20-million amp current pulse. This arrangement will permit four measurements, one for each pair of samples in which one pair is on each panel at the same position. **Photo by Leo Molina**


firings, and about one-third the data, was considered the standard for results up to 400 gigapascals was because Z’s sample size was roughly 10 times as big: 600 to 1,600 microns thick compared to 60 to 90 microns thick on NIF. A micron is a thousandth of a millimeter.

Larger samples, slower pulses equal easier measurements

“Because they were larger, Z’s samples were less sensitive to the microstructure of the material than were NIF’s,” said Jean-Paul. “Larger samples and slower pulses are simply easier to measure to high relative precision.

“Combining the two facilities really tightly constrained the standards,” he said.

Combining Z and NIF data meant that the higher-accuracy, but lower-intensity Z data could be used to pin down the low-to-medium pressure response, and with mathematical adjustments, reduce error on the higher-pressure NIF data.

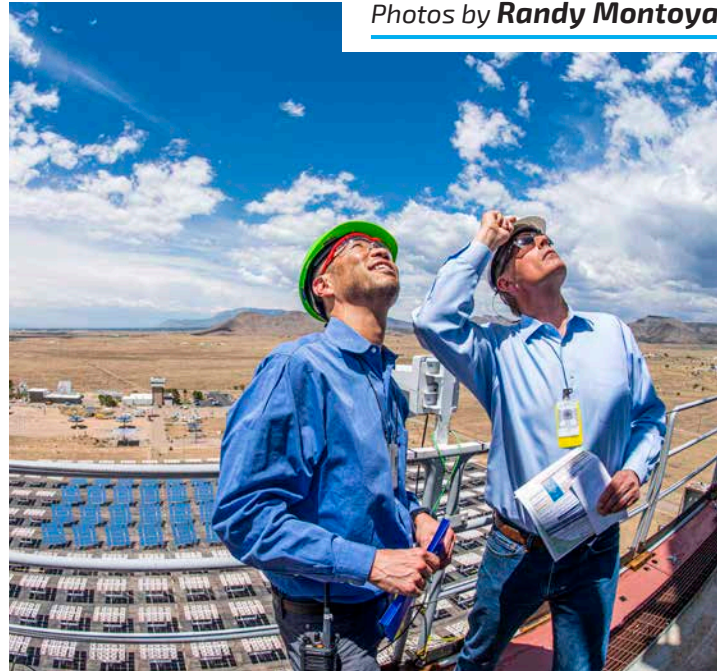
“The purpose of this study was to produce highly accurate pressure models to approximately one terapascal. We did that, so this combination of facilities has been advantageous,” said Chris. 

Sandia plays host to New Mexico solons



LOOKING FORWARD — On June 2, Labs Director James Peery welcomed Sen. Ben Ray Lujan for a firsthand look at the groundbreaking work happening at the Labs. The day started with an overview of Sandia's nuclear deterrence mission. The senator then stopped by the [Quantum Scientific Computing Open User Testbed](#) and gave closing remarks at the Center for Integrated Nanotechnologies. Ben Ray Lujan was sworn into office on Jan. 3, as senator after previously serving as representative for New Mexico's Third Congressional District.

Photos by **Randy Montoya**



A BRIGHT FUTURE — Sandia hosted Sen. Martin Heinrich, right, on June 3 to share the Labs' work in renewable energy. The senator toured the Battery Test Facility for an update on Sandia's research and development for energy storage and a demonstration of a new Sandia software, [Quest](#). He also learned about research on hydrogen fuel and toured the National Solar Thermal Test Facility, where Cliff Ho, left, showed the senator the [Falling Particle Receiver](#). He also toured the Microgrid facility and was briefed on improving energy resilience. Martin Heinrich was elected senator in 2012 and serves on the Senate Energy and Natural Resources, Armed Services, Intelligence and Joint Economic Committees.

Acoustic sensors

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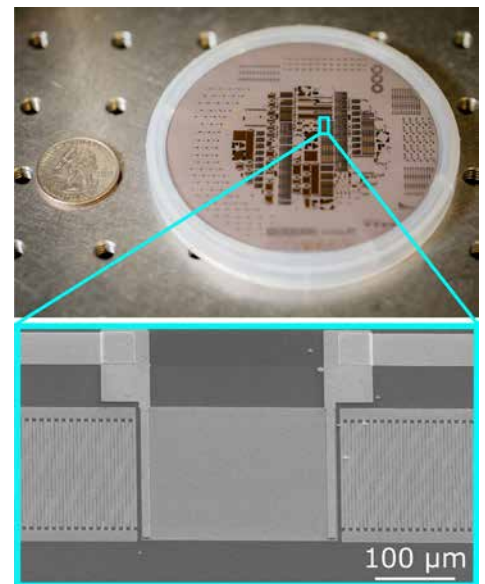
effective than the earlier versions. The design and future research directions hold promise for smaller wireless technology.

Modern cellphones are packed with radios to send and receive phone calls, text messages and high-speed data. The more radios in a device, the more it can do. While most radio components, including amplifiers, are electronic, they can potentially be made smaller and better as acoustic devices. This means they would use sound waves instead of electrons to process radio signals.

"Acoustic wave devices are inherently compact because the wavelengths of sound at these frequencies are so small — smaller than the diameter of human hair," Sandia scientist Lisa Hackett said. But until now, using sound waves has been impossible for many of these components.

Sandia's acoustic, 276-megahertz amplifier, measuring a mere 0.0008 square inch (0.5 square millimeter), demonstrates the vast, largely untapped potential for making radios smaller through acoustics. To amplify 2 gigahertz frequencies, which carry much of modern cellphone traffic, the device would be even smaller, 0.00003 square inch (0.02 square millimeter), a footprint that would comfortably fit inside a grain of table salt and is more than 10 times smaller than current state-of-the-art technologies.

The team also created the first acoustic circulator, another crucial radio component that separates transmitted and received signals. Together, the petite parts represent an essentially uncharted path toward making all technologies that send and receive information with radio waves smaller and more sophisticated, said Sandia scientist Matt Eichenfield.



A SOUND DESIGN — An acousto-electric chip, top, includes a radio-frequency amplifier, circulator and filter. An image taken by scanning electron microscopy shows details of the amplifier.

Microscopy image courtesy of Matt Eichenfield

“We are the first to show that it’s practical to make the functions that are normally being done in the electronic domain in the acoustic domain,” Matt said.

Resurrecting a decades-old design

Scientists tried making acoustic radio-frequency amplifiers decades ago, but the last major academic papers from these efforts were published in the 1970s.

Without modern nanofabrication technologies, their devices performed too poorly to be useful. Boosting a signal by a factor of 100 with the old devices required 0.4 inch (1 centimeter) of space and 2,000 volts of electricity. They also generated lots of heat, requiring more than 500 milliwatts of power.

The new and improved amplifier is more than 10 times as effective as the versions built in the ‘70s in a few ways. It can boost signal strength by a factor of 100 in 0.008 inch (0.2 millimeter) with only 36 volts of electricity and 20 milliwatts of power.

Previous researchers hit a dead end trying to enhance acoustic devices, which are not capable of amplification or circulation on their own, by using layers of semiconductor materials. For their concept to work well, the added material must be very thin and very high quality, but scientists only had techniques to make one or the other.

Decades later, Sandia developed techniques to do both in order to improve photovoltaic cells by adding a series of thin layers of semiconducting materials. The Sandia scientist leading that effort happened to share an office with Matt.

“I had some pretty heavy peripheral exposure. I heard about it all the time in my office,” Matt said. “So fast forward probably three years later, I was reading these papers out of curiosity about this acousto-electric amplifier work and reading about what they tried to do, and I realized that this work that Sandia had done to develop these techniques for essentially taking very, very thin semiconductors and transferring them onto other materials was exactly what we would need to make these devices realize all their promise.”

Sandia made its amplifier with semiconductor materials that are 83 layers of


atoms thick — 1,000 times thinner than a human hair.

Fusing an ultrathin semiconducting layer onto a dissimilar acoustic device took an intricate process of growing crystals on top of other crystals, bonding them to yet other crystals and then chemically removing 99.99% of the materials to produce a perfectly smooth contact surface. Nanofabrication methods like this are collectively called heterogeneous integration and are a research area of growing interest at Sandia’s **Microsystems Engineering, Science and Applications** complex and throughout the semiconductor industry.

Amplifiers, circulators and filters are normally produced separately because they are dissimilar technologies, but Sandia produced them all on the same acousto-electric chip. The more technologies that can be made on the same chip, the simpler and more efficient manufacturing becomes. The team’s research shows that the remaining radio signal processing components could conceivably be made as extensions of the devices already demonstrated.

Work was funded by Sandia’s **Laboratory Directed Research & Development** program and the **Center for Integrated Nanotechnologies**, a user facility jointly operated by Sandia and Los Alamos national laboratories.

So how long until these petite radio parts are inside your phone? Probably not for a while, Matt said. Converting mass-produced, commercial products like cellphones to all acousto-electric technology would require a massive overhaul of the manufacturing infrastructure, he said. But for small productions of specialized devices, the technology holds more immediate promise.

The Sandia team is now exploring whether they can adapt their technology to improve all-optical signal processing, too. They are also interested in finding out if the technology can help isolate and manipulate single quanta of sound, called phonons, which would potentially make it useful for controlling and making measurements in some quantum computers. 

MISSION
FORWARD

Vaccinate
today for
a healthy
tomorrow.



They're safe. They keep you safe. They keep others safe.

coronavirus.sandia.gov

Fourth graders on virtual field trip witness magic of chemistry



Photos by **Amy Tapia**


Sandia's Advanced Materials Laboratory recently staged a remote chemistry field trip for 200 fourth graders, who visited from their screens from five Title One elementary schools in Albuquerque. Researchers conducted the demonstrations after providing kits for the students to make lava lamps, Oobleck, gummy molecules and catapults. The students also enjoyed the ever-popular liquid nitrogen and Mentos demonstrations.

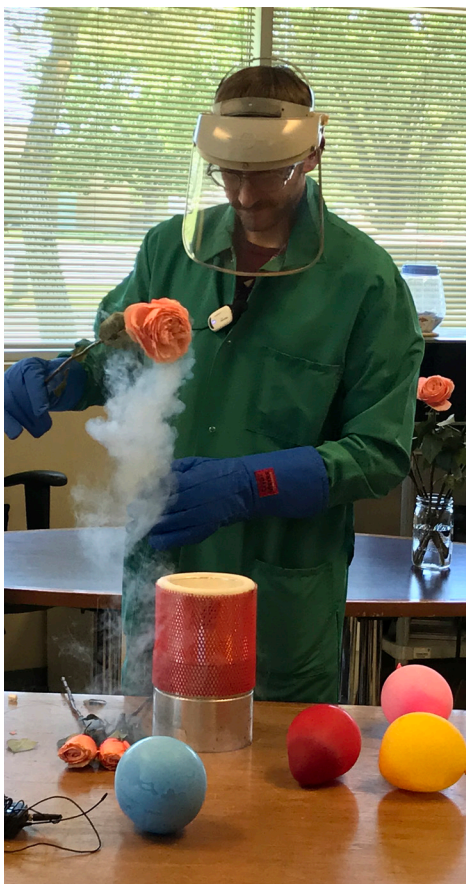
Chemist LaRico Treadwell worked with his laboratory team of postdocs and student interns to come up with fun activities that could be done safely at home or in the classroom. With support from Angela Walde, the team provided material kits for every student. After a short safety briefing, the students got to meet Sandia chemists and to become junior scientists themselves.



COOL CHEMISTRY — In the photos above, Eryal Rhinehart and Marissa Ringgold watch in suspense as they create the basics of lava lamps (top left); Claire Davis-Wheeler shows the far-flung student audience how to put together molecules from gummy fruit snacks (top right); and the Advanced Materials Laboratory team, left to right, Avi Bregman, Eryal, Alyssa Vallejos and Patricia Hernandez, gets ready to launch their Mentos volcanos (bottom).

Activities will be available soon on the [Kids Day website](#).

The Advanced Materials Laboratory opened in 1992 to foster collaborations among Sandia, the University of New Mexico and private companies. Its primary focus is research on the synthesis and characterization of materials and on processing and manufacturing. 



POP! GO THE MENTOS — In the photos above, Avi, Eryal, Alyssa and Patricia stand back to watch the resulting volcanic plumes (top right); Avi immortalizes a rose by dipping it in liquid nitrogen (left); and event organizer LaRico Treadwell holds the camera so the students can watch Harold Lee dissolve plastics in acetone under a chemical fume hood (bottom right).